

WHAT IS CLAIMED IS:

1. An aqueous sizing composition comprising:
 - (a) an emulsion comprising an alkenylsuccinic anhydride
 - 5 component containing alkenylsuccinic anhydride particles suspended in a first starch component containing emulsifying starch selected from the group consisting of non-ionic starches, anionic starches, cationic starches and mixtures thereof, and
 - (b) a second starch component selected from the group
 - 10 consisting of non-ionic starches, cationic starches, anionic starches and mixtures thereof,
 - wherein the alkenylsuccinic anhydride component and the starch in the emulsion and the second starch component are present at a starch:alkenylsuccinic anhydride weight ratio that is sufficiently high to enable the sizing composition to impart useful sizing properties to a fibrous substrate when the sizing
 - 15 composition contacts the fibrous substrate.
2. The sizing composition of Claim 1, wherein the starch:alkenylsuccinic anhydride weight ratio is at least about 10:1.
3. The sizing composition of Claim 1, wherein the emulsifying starch in the first starch component in the emulsion has a starch: alkenylsuccinic
- 20 anhydride weight ratio ranging from about at least 0.2:1 to about 10:1.
4. The sizing composition of Claim 1, wherein the particles have a median particle size ranging from about 0.5 to about 20 microns.
5. The sizing composition of Claim 1, wherein the emulsion further comprises a surfactant component in an amount ranging from about
- 25 0.1 wt.% to about 20 wt.%, based on the total amount of alkenylsuccinic anhydride.
6. The sizing composition of Claim 1, wherein the an alkenylsuccinic anhydride component includes hydrolyzed alkenylsuccinic anhydride in an amount ranging from about 1 to about 99%, based on the total weight of the emulsion.
7. The sizing composition of Claim 1, wherein the
- 30 sizing composition has a starch:alkenylsuccinic anhydride component weight ratio that is sufficiently high so that when the sizing composition treats a fibrous substrate, the treated fibrous substrate has a Cobb sizing of less than about 150 gsm for 30 minutes or about 100 gsm for two minutes.

8. The sizing composition of Claim 1, wherein the starch:alkenylsuccinic anhydride component weight ratio is sufficiently high so that if the sizing composition treats a fibrous substrate, the treated fibrous substrate retards ink penetration, giving an HST value of at least ten seconds.

5 9. The sizing composition of Claim 1, wherein the starch:alkenylsuccinic anhydride ratio is sufficiently high to minimize the sizing composition from coalescing at a temperature ranging from about 100 to about 180 °F.

10. The sizing composition of Claim 1, wherein the suspended alkenyl succinic anhydride particles have a monomodal particle distribution.

10 11. The sizing composition of Claim 1, wherein the alkenyl succinic anhydride component comprising particles suspended in non-ionic and/or ionic starch have a bimodal or a multimodal particle distribution.

12. A fibrous substrate treated with the sizing composition of Claim 1.

15 13. The fibrous substrate of Claim 12, wherein the substrate is paperboard.

14. The fibrous substrate of Claim 12, wherein the substrate is fine paper.

20 15. The fibrous substrate Claim 12, wherein the substrate is a newsprint or other wood-containing papergrades.

16. A process for making a sizing composition comprising the sequential steps of:

(a) emulsifying alkenylsuccinic anhydride with a first starch component containing starch selected from the group consisting of non-ionic
25 starches, ionic starches, and mixtures thereof, and thereby forming an emulsion, and

(b) combining the emulsion with a second starch component selected from the group consisting of non-ionic starches, ionic starches, and mixtures thereof, and thereby forming a sizing composition comprising

(1) an emulsion comprising an alkenylsuccinic anhydride component containing
30 alkenylsuccinic anhydride particles suspended in a first starch component containing emulsifying starch selected from the group consisting of non-ionic starches, ionic starches, and mixtures thereof, and

(2) a second starch component selected from the group

consisting of non-ionic starches, ionic starches and mixtures thereof, such that the alkenylsuccinic anhydride and the starch in the emulsion and the second starch component are present at a starch:alkenylsuccinic anhydride weight ratio that is sufficiently high to enable the sizing composition to impart useful sizing properties to a fibrous substrate when the sizing composition contacts the fibrous substrate.

17. A process for sizing a paper product comprising:

- (a) adding, to a pulp slurry, a wet end sizing agent component;
- (b) forming a fibrous sheet from the slurry, and
- (c) treating the fibrous sheet with a sizing composition comprising:

(1) an emulsion comprising an alkenylsuccinic anhydride component containing alkenylsuccinic anhydride particles suspended in a first starch component containing emulsifying starch selected from the group consisting of non-ionic starches, ionic starches, and mixtures thereof, and

(2) a second starch component selected from the group consisting of non-ionic starches, ionic starches and mixtures thereof, and thereby imparting useful sizing properties to the fibrous substrate.

18. The process of Claim 17, wherein the wet end sizing agent component contains a sizing agent selected from the group consisting of ketene dimers, ketene multimers, rosin, alkenylsuccinic anhydrides, organic epoxides containing from about 12 to 22 carbon atoms, acyl halides containing from about 12 to 22 carbon atoms, fatty acid anhydrides from fatty acids containing from about 12 to 22 carbon atoms and organic isocyanates containing from about 12 to 22 carbon atoms, and combinations thereof.

19. The process of Claim 17, wherein the wet end sizing agent component contains cationic starch and a sizing agent selected from the group consisting of ketene dimers and multimers, alkenylsuccinic anhydrides, organic epoxides containing from about 12 to 22 carbon atoms, acyl halides containing from about 12 to 22 carbon atoms, fatty acid anhydrides from fatty acids containing from about 12 to 22 carbon atoms and organic isocyanates containing from about 12 to 22 carbon atoms.

20. The process of Claim 17, wherein the wet end sizing agent component contains cationic starch and alkenylsuccinic anhydride.

21. The process of Claim 17, wherein the alkenylsuccinic anhydride in the wet end sizing agent component is present in an amount that is less than the total sizing agent used.

22. The process of Claim 17, wherein the wet end sizing agent component is present in an amount that is 50% or less of the total sizing agent used.

23. A process for sizing fine paper comprising treating a fibrous sheet with an aqueous sizing composition comprising:

5 (a) an emulsion comprising an alkenylsuccinic anhydride component containing alkenylsuccinic anhydride particles suspended in a first starch component containing emulsifying starch selected from the group consisting of non-ionic starches, ionic starches, and mixtures thereof, and

10 (b) a second starch component selected from the group consisting of non-ionic starches, ionic starches and mixtures thereof, and thereby imparting useful sizing properties to the fine paper.

24. The process of Claim 23, wherein the sizing composition is added to a water box.

25. The process of Claim 23, wherein about 100% of the alkenylsuccinic anhydride in the sizing composition is retained in the fibrous substrate.

26. A process for sizing a fibrous substrate comprising:

15 (a) emulsifying alkenylsuccinic anhydride with a first starch component containing starch selected from the group consisting of non-ionic starches, ionic starches, and mixtures thereof, and thereby forming an emulsion,

(b) combining the emulsion with a second starch component selected from the group consisting of non-ionic starches, ionic starches, and mixtures thereof, and thereby forming a sizing composition comprising:

20 (1) an emulsion comprising an alkenylsuccinic anhydride component containing alkenylsuccinic anhydride particles suspended in a first starch component containing emulsifying starch selected from the group consisting of non-ionic starches, ionic starches, and mixtures thereof,

25 (2) a second starch component selected from the group consisting of non-ionic starches, ionic starches and mixtures thereof,

wherein the alkenylsuccinic anhydride and the starch in the emulsion and the second starch component are present at a starch:alkenylsuccinic anhydride weight ratio that is sufficiently high to enable the sizing composition to impart useful sizing properties to a fibrous substrate when the sizing composition contacts the fibrous substrate, and

(c) treating a fibrous sheet with the sizing composition, and thereby imparting useful sizing properties to the fibrous substrate.

27. The process of Claim 26, wherein the substrate is paperboard.

28. The process of Claim 26, wherein the substrate is fine paper. 29. The process of Claim 26, wherein the substrate is newsprint or other wood-containing paper grades.

30. An aqueous sizing composition made by a process comprising:

- (a) emulsifying alkenylsuccinic anhydride with a first starch component containing starch selected from the group consisting of non-ionic starches, ionic starches, and mixtures thereof, and thereby forming an emulsion, and
- 5 (b) combining the emulsion with a second starch component selected from the group consisting of non-ionic starches, ionic starches, and mixtures thereof, and thereby forming the sizing composition, wherein the composition comprises:
- (1) first component including an emulsion comprising an alkenylsuccinic anhydride component containing alkenylsuccinic anhydride particles suspended in a
- 10 first starch component containing emulsifying starch selected from the group consisting of non-ionic starches, ionic starches, and mixtures thereof, and
- (2) a second starch component selected from the group consisting of non-ionic starches, ionic starches and mixtures
- 15 wherein the alkenylsuccinic anhydride and the starch in the emulsion and the second starch component are present at a starch:alkenylsuccinic anhydride weight ratio that is sufficiently high to enable the sizing composition to impart useful sizing properties to a fibrous substrate when the sizing composition contacts the fibrous substrate.

31. A sized fibrous substrate made by a process comprising:

- (a) emulsifying alkenylsuccinic anhydride with a
- 20 first starch component containing starch selected from the group consisting of non-ionic starches, ionic starches, and mixtures thereof, and thereby forming an emulsion, and
- (b) combining the emulsion with a second starch component selected from the group consisting of non-ionic starches, ionic starches, and mixtures thereof, and forming an aqueous sizing composition comprising:
- 25 (1) an emulsion comprising an alkenylsuccinic anhydride component containing alkenylsuccinic anhydride particles suspended in a first starch component containing

emulsifying starch selected from the group consisting of non-ionic starches, ionic starches, and mixtures thereof, and

(2) a second starch component selected from the group consisting of non-ionic starches, ionic starches and mixtures thereof;

wherein the alkenylsuccinic anhydride and the starch in the emulsion and the second starch component are present at a starch:alkenylsuccinic anhydride weight ratio that is sufficiently high to enable the sizing composition to impart useful sizing properties to a fibrous substrate when the sizing composition contacts the fibrous substrate, and

(c) treating a fibrous substrate with the aqueous sizing composition, and thereby forming a sized fibrous substrate.

32. The fibrous substrate of Claim 31, wherein the fibrous substrate is selected from the group consisting of board, fine paper, newsprint, and other wood-containing grades.

5 33. An aqueous sizing composition comprising:

(a) an emulsion comprising an alkyl ketene dimer component containing alkyl ketene dimer particles suspended in a first starch component containing emulsifying starch selected from the group consisting of non-ionic starches, anionic starches, and mixtures thereof, and

10 (b) a second starch component selected from the group consisting of non-ionic starches, cationic starches, anionic starches and mixtures thereof,

wherein the alkyl ketene dimer component and the starch in the emulsion and the second starch component are present at a starch: alkyl ketene dimer weight ratio that is sufficiently high to enable the sizing composition to impart useful sizing properties to a fibrous substrate when the sizing composition contacts the fibrous substrate.

15